PRICE 50 CENTS

RCA SENIOR VOLTOHMYST®

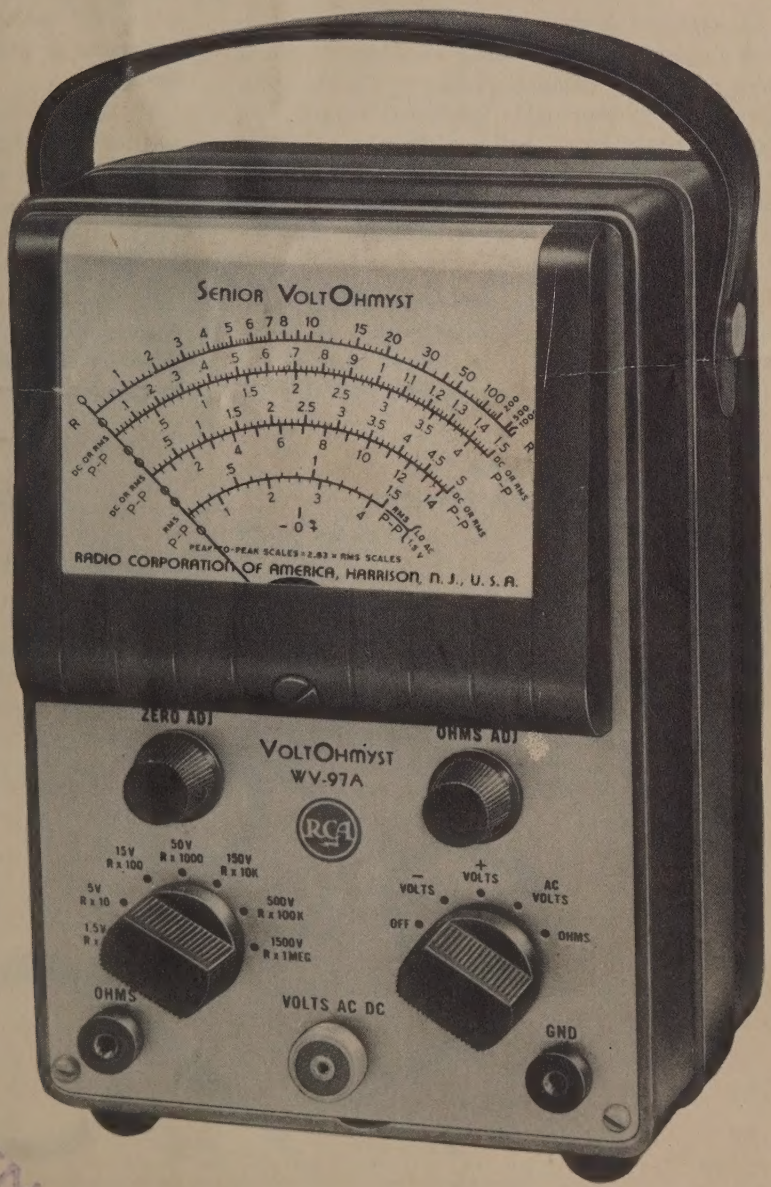
RETURN TO AEROSPACE DIV.

C7

ELECTRONIC METER

Type WV-97A

- Specifications
- Operation
- Applications
- Maintenance



ELECTRONIC SCIENCE RETURN TO LIBRARY

Richard Buell

RADIO CORPORATION of AMERICA
TEST AND MEASURING EQUIPMENT HARRISON, N. J.

Safety Precautions

The metal case of this instrument is connected to the ground of the internal circuit. For proper operation, the ground terminal of the instrument should always be connected to the ground of the equipment under test. The WG-218 Direct Probe and Cable has a shield throughout its entire length which is connected to the instrument ground and case. Always handle the WG-218 by the insulated probe housing.

An important point to remember is that there is always danger inherent in testing electrical equipment which operates at hazardous voltages. Therefore, the operator should thoroughly familiarize himself with the equipment under test before working on it, bearing in mind that high voltages may appear at unexpected points in defective equipment. Additional precautions which experience in the industry has shown to be important are listed below.

1. It is good practice to remove power before connecting test leads to high-voltage points. If this is impractical, be *especially careful* to avoid accidental contact with equipment racks and other objects which can provide a ground. Working with one hand in your pocket and standing on a properly insulated floor lessens the danger of shock.

2. Filter capacitors may store a charge large enough to be hazardous. Therefore, discharge filter capacitors before attaching test leads.

3. Remember that leads with broken insulation provide the additional hazard of high voltages appearing at exposed points along the leads. Check test leads for frayed or broken insulation before working with them.

4. To lessen the danger of accidental shock, disconnect test leads immediately after test is completed.

5. Remember that the risk of severe shock is only one of the possible hazards. Even a minor shock can place the operator in hazard of more serious risks such as a bad fall or contact with a source of higher voltage.

6. The experienced operator continuously guards against injury and does not work on hazardous circuits unless another person is available to assist in case of accident.

ITEMS

Supplied with WV-97A:

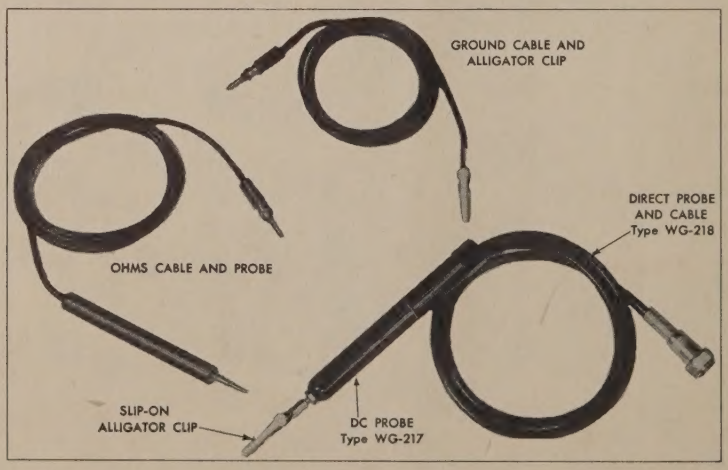
1 Direct Probe and Cable.....Type No. WG-218
1 DC Probe .....Type No. WG-217
1 Ohms Cable, with probe.....Stock No. 51960
1 Ground Cable, with alligator clip.....Stock No. 48996
1 Slip-On Alligator Clip.....Stock No. 59410
1 1.5-Volt Battery.....Type No. VS036
1 RCA-12AU7 Tube
2 RCA-6AL5 Tubes
1 Warranty Certificate
1 Instruction Booklet

ACCESSORIES

Available on Separate Order:

For Measuring AC Voltages at Frequencies from 50 Kc to 250 Mc:
Crystal Probe .....Type No. WG-264

For Increasing DC Voltage Range to 50,000 Volts:
High-Voltage Probe .....Type No. WG-289
Multiplier Resistor .....Type No. WG-206


GROUND CABLE AND ALLIGATOR CLIP
DIRECT PROBE AND CABLE Type WG-218
OHMS CABLE AND PROBE
SLIP-ON ALLIGATOR CLIP
DC PROBE Type WG-217

Cables and Probes supplied with the WV-97A

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SENIOR VOLTOHMYST

Type WV-97A

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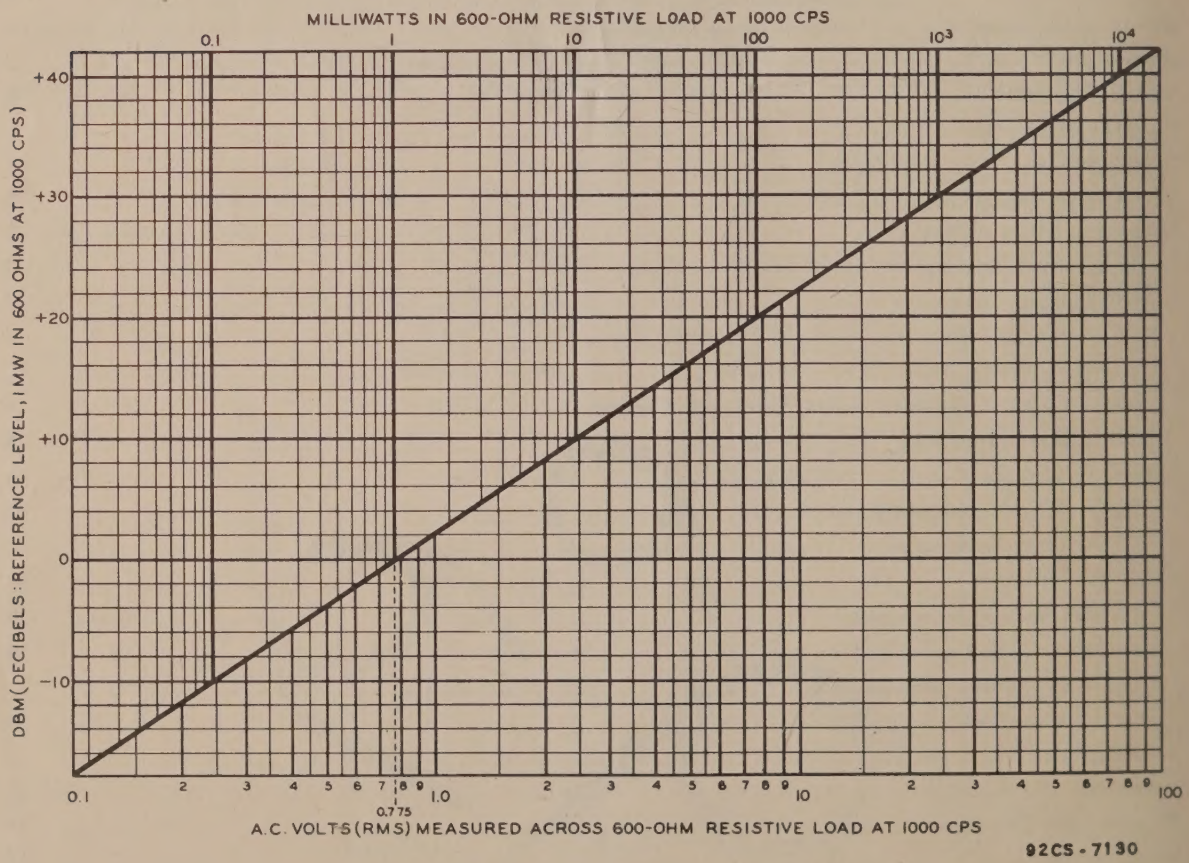


Note: For loads other than 600 ohms, see table on page 11.

Figure 1. Chart for conversion of rms voltage to dbm values.

General Description

Especially designed for use as a television signal tracer, the RCA WV-97A Senior VoltOhmyst* features a circuit which measures peak-to-peak voltages for both sine waves and complex waves. In addition, the WV-97A reads dc voltages, resistance values, and rms voltage values of sine waves.

The WV-97A has the high input resistance of 11 megohms on all dc ranges and is frequency-compensated for ac voltage ranges up to and including the 500-volt range. (500 v. rms or 1400 v. p-p). The frequency range of the instrument, depending on the impedance of the voltage source, is flat to approximately 3 megacycles. When the auxiliary WG-264 Crystal Probe is used, the voltage ranges are accurate to within ± 10% from 50 kc to 250 Mc.

The Senior VoltOhmyst features a circuit which measures the peak-to-peak voltages of the complex waveshapes found in modern television receivers and industrial equipment. Since the meter reading is proportional to the peak-to-peak value of the waveshape measured, negligible waveform error is introduced in the measurement, as may be the case with meters having readings proportional to either the positive or the negative peak of the waveshape.

The RCA Senior VoltOhmyst utilizes a push-pull amplifier-type of dc bridge circuit which affords excellent linearity of response, good stability, and very high input impedance. (See Schematic Diagram, tube V3 and associated network.) When no measurement is being made, the cathode currents through the triode units are equal. When a measurement is being made, a voltage is applied to the grid of triode unit #1 to provide a change in the cathode current of this triode unit. Since resistor R20 functions as a cathode-coupling element, the change in cathode current through R20 alters the grid-to-cathode potential of triode unit #2, a condition which modifies the cathode current of triode unit #2. When, for example, the current flow through triode unit #1 increases, the flow of current through triode unit #2 decreases. The meter reading is proportional to the difference between the plate currents of the triodes.

Additional features of the WV-97A include provision for zero-center indication, useful in discriminator and bias measurements; separate scales for low ac voltage measurements; a circuit design which allows measurements of the ac component of a signal when the dc component is present and vice versa; a separate dc probe with a 1-megohm resistor which minimizes capacitance-loading effects; and electronic protection against meter burn-out.

The RCA WV-97A Senior VoltOhmyst is a lightweight, compact, and versatile instrument. A reliable measuring device, it will prove extremely useful in television applications as well as in many industrial applications.

*Trade Mark "VoltOhmyst" Reg. U. S. Pat. Off.

Specifications

Electrical

DC Voltmeter:

Ranges.....0 to 1.5, 5, 15, 50, 150, 500, 1500 volts

Input Resistance (With DC Probe WG-217 attached to Direct Probe & Cable WG-218):

All Ranges.....11 megohms

Sensitivity on 1.5-V Range.....7.3 megohms/volt

Overall Accuracy..... ±3% of full scale

AC Voltmeter: (For instruments with code numbers 350.)

Ranges:

RMS Values of Sine Waves..... {0 to 1.5 volts on separate LO-AC scale; 0 to 5, 15, 50, 150, 500, 1200 volts▲}

Peak to Peak Values of Sine Waves & Complex Waves..... {0 to 4 volts on separate LO-AC scale; 0 to 14, 42, 140, 420, 1400, 3400 volts▲}

Overall Accuracy..... ±5% of full scale

Input Resistance and Capacitance (With Direct Probe & Cable WG-218):

1.5, 5, 50, 150-V Ranges..... 0.83 meg. shunted by 70 μμf

500-V Range..... 1.3 meg. shunted by 60 μμf

1200-V Range..... 1.5 meg. shunted by 60 μμf

Frequency Response:

With Direct Probe & Cable WG-218* { 30 cps to 3 Mc□; 30 cps to 500 kc△; 30 cps to 270 kc○; 30 cps to 80 kc◆ }

With Crystal Probe WG-264* ..... { within ± 10% from 50 kc to 250 Mc }

Pulse Response Capability..... See Fig. 7

▲CAUTION: See Maximum Input Voltages.

AC Voltmeter: (For instruments with all code numbers except 350.)

Ranges:

RMS Values of Sine Waves..... { 0 to 1.5 volts on separate LO-AC scale; 0 to 5, 15, 50, 150, 500, 1500 volts

Peak to Peak Values of Sine Waves & Complex Waves..... { 0 to 4 volts on separate LO-AC scale; 0 to 14, 42, 140, 420, 1400, 4200 volts

Overall Accuracy..... ±5% of full scale

Input Resistance and Capacitance (With Direct Probe & Cable WG-218):

1.5, 5, 50, 150-V Ranges.....0.83 meg. shunted by 70 μμf

500-V Range..... 1.3 meg. shunted by 60 μμf

1200-V Range..... 1.5 meg. shunted by 60 μμf

Frequency Response:

With Direct Probe & Cable WG-218* { 30 cps to 3 Mc□; 30 cps to 500 kc△; 30 cps to 270 kc○; 30 cps to 80 kc◆

With Crystal Probe WG-264* ..... { within ± 10% from 50 kc to 250 Mc

Pulse Response Capability.....See Fig. 7

Ohmmeter:

Ranges, Seven.....0 to 1000 megohms

Meter Movement:

DC Current for Full-Scale Deflection.....200 μa

Tube Complement:.....2 RCA-6AL5, 1 RCA-12AU7

Power Supply:

Voltage Rating.....105-125 volts

Frequency Rating..... 50/60 cps

Power Consumption (Approx.).....6 watts

Battery (1.5-volt cell).....1 RCA-VS036

Maximum Input Voltages: (For instruments with code numbers 350.)

DC Voltages with no ac voltage present:..... 1500 volts

AC Voltages with no dc voltage present:

RMS for Sine Waves.....1200 volts

Peak-to-Peak for Sine Waves..... 3400 volts

Peak-to-Peak for Complex Waves..... 1400 volts

Combined AC and DC Voltages—

Sum of DC Voltage and AC Peak Voltage:

AC Component Measurements..... 1400 volts

DC Component Measurements.....1500 volts

Maximum Input Voltages: (For instruments with all code numbers except 350.)

DC Voltages with no ac voltage present:.....1500 volts

AC Voltages with no dc voltage present:

RMS for Sine Waves..... 1500 volts

Peak-to-Peak for Sine Waves..... 4200 volts

Peak-to-Peak for Complex Waves..... 2000 volts

Combined AC and DC Voltages—

Sum of DC Voltage and AC Peak Voltage..... 2000 volts

Mechanical

Overall Dimensions:

Height ..... 7⅞ inches

Width ..... 5¾ inches

Depth ..... 4½ inches

Weight ..... 5½ pounds

Finish..... { blue-gray hameroid case; satin aluminum panel

*For ac voltage ranges up to and including the 500-volt range (500 v. rms or 1400 v. p-p).

□For source impedances of approximately 100 ohms or lower. Response is up about 10% at 3 Mc.

△For source impedances of approximately 1000 ohms or lower. Response is up about 10% at 500 kc.

○For source impedances of approximately 5000 ohms or lower. Response is down about 10% at 270 kc.

◆For source impedances of approximately 10000 ohms or lower. Response is down about 10% at 80 kc.

•Available on separate order.

Functions of Controls and Terminals

Function selector—Has two functions; turns the power off in "OFF" position, and permits choice of type of measurement to be made.

Range selector—Permits choice of range for the desired voltage or resistance measurements.

ZERO ADJ control—Used to position the meter pointer at either the left-hand "0" position or, when function selector is set to "+VOLTS," to the zero-center "—0+" position.

OHMS ADJ control—Used to position the meter pointer at the extreme right line on the "R" scale when the function selector is in "OHMS" position.

VOLTS AC DC terminal—Voltages to be measured are applied between this terminal and the GND terminal by means of the probes and cables specified under "Operation" below.

OHMS terminal—Resistances to be measured are connected between this terminal and the GND terminal.

GND terminal—is directly connected to the chassis of the instrument; serves as a common ground for the WV-97A and the chassis of the equipment under test as well as for associated test instruments.

Operation and Applications

Preliminary Adjustments:

To prepare the WV-97A for use, make the following connections and adjustments:

1. Connect the Direct Probe and Cable to the VOLTS AC DC terminal, the Ground Cable to the GND terminal, and the Ohms Cable to OHMS terminal.
2. Plug the power cord into an ac outlet supplying 105-125 volts at 50/60 cycles, and adjust the controls as indicated below:
   a. Turn the function selector to "+VOLTS" position, and allow several minutes for the instrument to warm up.
   b. Adjust the ZERO ADJ control to position the meter pointer at the left-hand "0".

   NOTE: To check this adjustment, notice whether or not the position of the meter pointer changes when the function selector is switched to "—VOLTS". If the pointer position changes, readjust the mechanical zero control as described in the Maintenance Section.

   c. Turn the function selector to "OHMS" position. The pointer should deflect to approximately full scale.
   d. Rotate the OHMS ADJ control to position the pointer at the last line on the "R" (ohms) scale.
   e. Turn the function selector to "AC VOLTS" position. If the meter pointer does not read zero volts when the range selector is set on "1.5V", refer to steps 2, 3, 4 of "AC Calibration" and to the "Electrical Balance Check" in the Maintenance Section.

The instrument is now ready for use.

DC-Voltage Measurements:

CAUTION: See Maximum Input Voltages, under "Specifications".

The WG-217 DC Probe must be used with the WG-218 Direct Probe and Cable for all dc-voltage measurements.

The WV-97A has seven dc-voltage ranges: 0 to 1.5, 5, 15, 50, 150, 500, and 1500 volts. Although the meter is protected against burnout, it is good practice to make a trial measurement at a higher range setting than is expected because long-continued or repeated overload of the meter movement may eventually impair the accuracy of indication.

To measure dc voltages, proceed as outlined below:

1. Set the function selector to "+VOLTS" or to "—VOLTS", as required.
2. Connect the Ground Cable clip to ground or low side of source voltage.

   CAUTION: See first paragraph of "Safety Precautions".
3. Set the range selector to a position considerably higher than the voltage to be measured.
4. Touch or connect the DC Probe to the high side of the source voltage.
5. Reset the range selector to a position which gives a suitable pointer deflection.
6. Read the dc voltage from the scale corresponding to the range-selector setting.

NOTE: Although the ground lead of the WV-97A must never be connected to a high-voltage point in a circuit, it is occasionally necessary to connect the ground lead to a "low-side" point which may be a few volts above ground. This "low-side" connection is permissible, but it should be remembered that the accuracy of the WV-97A may be impaired if an appreciable potential exists between GND terminal and the power-line ground.

Zero-Center Indication:

Zero-center indication is frequently useful because it allows observation of either positive or negative dc-voltage excursions without the necessity of resetting the function selector.

1. Set the function selector to "+VOLTS".
2. Rotate the ZERO ADJ control to position the pointer at the center "—0+".
3. Set the range selector to a position at least double the voltage to be measured.
4. After a test reading has been made, the range selector may be set to the lowest position which allows the pointer to remain on the scale.

Resistance Measurements:

The Ohms Cable is used in making all resistance measurements.

Before resistance measurements are made, the power should be removed from the equipment under test so that no voltages are present in the equipment.

1. Set the function selector to "OHMS" position.
2. Set the range selector to "R x 10" position.

3. Connect the Ohms Probe to the Ground Cable and adjust the ZERO ADJ control to position the pointer at the left-hand "0" if necessary.
4. Disconnect Ohms Probe from Ground Cable. Meter pointer will deflect approximately full scale. If meter pointer does not deflect to exactly full scale, use OHMS ADJ control to obtain full deflection.
5. Connect the clip of the Ground Cable to one terminal of the resistance to be measured.
6. Touch or connect the Ohms Probe to the other terminal of the resistance to be measured.
7. Reset the range switch to give a convenient deflection on the "R" (ohms) scale. See Ohms Adjustment section on page 15.
8. Multiply the reading on the "R" scale by the factor indicated at the range-selector setting.
   CAUTION: Low-current, low-resistance devices, such as thermocouples and meter movements, may be damaged unless a range above "R x 10" is used because the WV-97A applies up to 1.5 volts across the resistance under measurement when the range selector is set at "R x 1" or "R x 10".

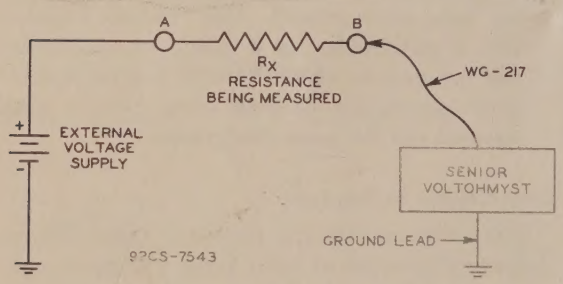


Figure 2. Circuit for measurement of resistance values above 1000 megohms.

When making resistance measurements, the Direct Probe of the WV-97A is always positive with respect to the Ground Cable. This arrangement facilitates the measurement of leakage resistance in components such as electrolytic capacitors where polarity must be observed.

Measurement of Resistance Values Above 1000 Megohms:

The leakage resistance of small mica and paper capacitors is usually above 1000 megohms. The circuit shown in Fig. 2 can be used to measure resistance values above 1000 megohms. An external dc voltage source between 20 and 500 volts is utilized to obtain a measurable pointer deflection. Make circuit connections as shown in Fig. 2 and proceed as follows:

1. Set Selector switch to "+VOLTS" and measure the voltage at point "B".
2. Measure the voltage at point "A".
3. Compute the unknown resistance from the following formula:

$$Rx\ (\text{megohms}) = \frac{11\ [(\text{Volts at "A"}) - (\text{Volts at "B"})]}{(\text{Volts at "B"})}$$

EXAMPLE:

An unknown resistance is to be determined with the circuit of Fig. 2. An external voltage of 500 volts is applied. The WV-97A measures 2.5 volts at "B", and 500 volts at "A". Then,

$$Rx = 11\ (500\text{-}2.5)\ /2.5 = 2200 \text{ megohms (approx.)}$$

AC Voltage Measurements:

CAUTION: See Maximum Input Voltages, Under "Specifications".

See discussion in Maintenance Section on Meter Response.

The WG-218 Direct Probe and Cable is used for ac-voltage measurements. (Remove the WG-217 DC Probe.)

1. Set the function selector at "AC VOLTS" position.
2. Adjust the ZERO ADJ control if necessary to position the meter pointer at the left-hand "0".
3. Set the range selector to a position considerably higher than the voltage to be measured.
4. Touch or connect the Direct Probe to the high side of the source voltage.

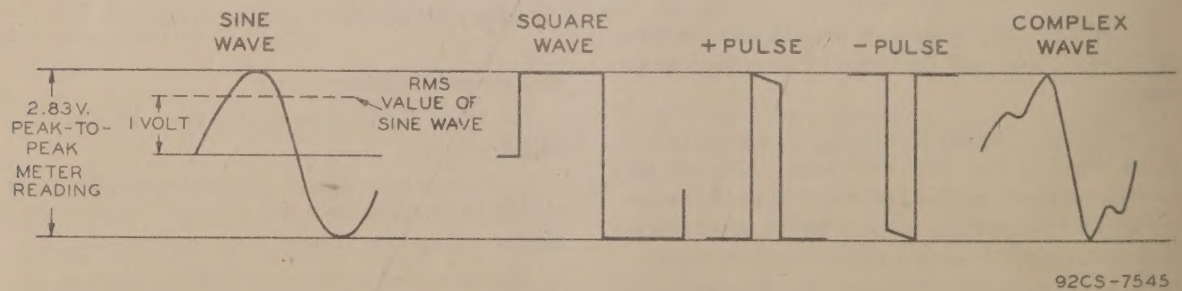


Figure 3. Typical voltage waveforms.

5. Reset the range selector to a position which gives a suitable pointer deflection.
6. Read the ac voltage from the scale corresponding to the range-selector setting.

RMS scales are in black, with full-scale values of 1.5, 5, 15, 50, 150, 500, and 1500 volts. Peak-to-peak scales are in red. AC voltages of 1.5 rms volts, or 4 peak-to-peak volts, or less are read on the lowest meter scales; higher voltages are read on the two center scales. The instrument has a rated input for non-symmetrical waves of 1400 or 2000 peak-to-peak volts. However, sine waves and symmetrical complex waves can be measured to 3400 or 4200 volts peak-to-peak with somewhat reduced frequency response. See *Maximum Input Voltages* on page 6. In the case of sine waves, the instrument is conveniently calibrated to read directly both rms values and peak-to-peak values. This is practical because the relation of peak-to-peak values to rms values for any sine wave is a fixed ratio of 2.83 to 1. For example, with the range selector set at "15 V" and a sine wave of 10 rms volts applied to the instrument, the meter pointer

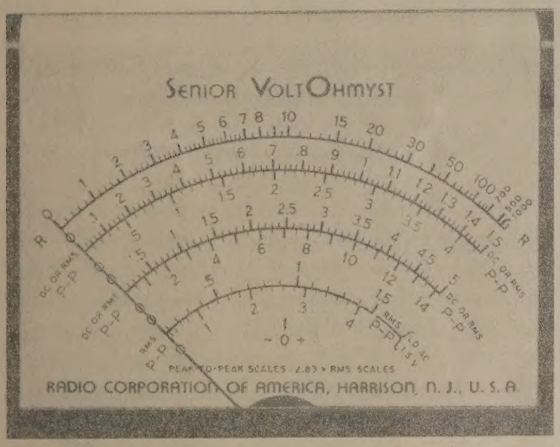


Figure 4. Details of WV-97A scales.

will rest at 10 on the rms black scale and at 28.3 on the associated peak-to-peak scale. Thus, the WV-97A reads both the rms and peak-to-peak values of sine waves simultaneously; as a peak-to-peak reading meter, the WV-97A is indispensable in trouble-shooting TV circuits. Typical TV voltage waveforms are shown in Fig. 5. Examples of some of the basic waveforms that can be measured with the WV-97A are shown in Fig. 6. When the WV-97A is used for ac measurements, certain precautions in interpreting the readings are necessary just as with all voltage-measuring instruments. Inaccurate readings may be obtained, if the impedance of the circuit under measurement is high, if the frequency of the voltage source is high, or if the voltage waveform consists of narrow pulses with a low repetition rate. The error of the readings increases with the ratio of the source impedance to the instrument impedance and varies with frequency (see "Electrical Specifications" on page 6 for information on the input resistance, input capacitance, and frequency response). Also, when narrow pulses with low repetition rates are measured, the capacitors in the peak-to-peak rectifier of the WV-97A have insufficient time during the pulse to charge fully, and too long a period between pulses to retain the charge. The magnitude of the error caused by this effect is shown in Fig. 7, which holds for essentially rectangular pulses derived from a source with an internal impedance of 50 ohms or lower. For sources having higher internal impedances, the error will be correspondingly greater.

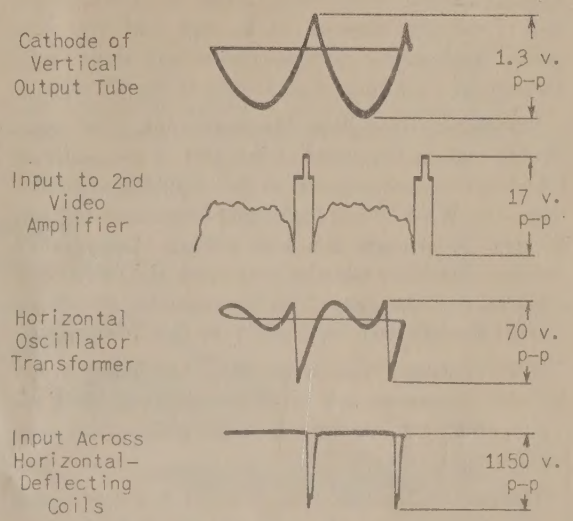


Figure 5. Typical TV voltage waveforms.

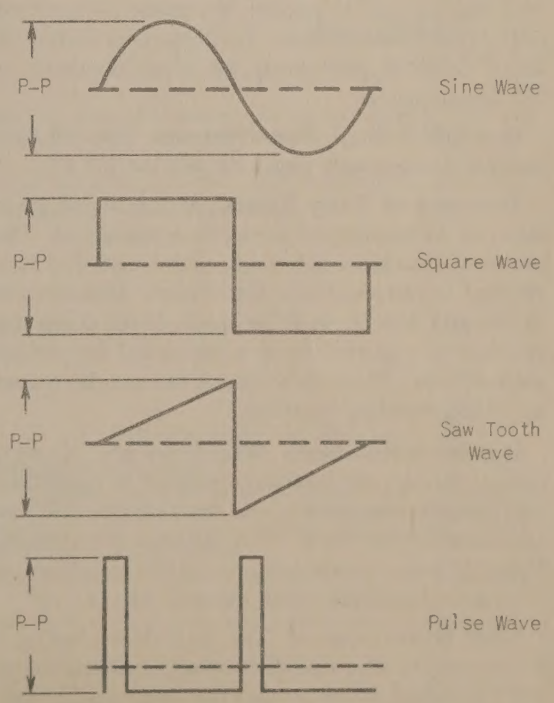


Figure 6. Voltage waveforms.

Special Applications

The WV-97A is generally useful in the maintenance and service of ac, dc, af, and pulsed electronic and electro-mechanical equipment. When used with the WG-264 Crystal-Diode Probe, it can be used to measure rf voltages between 50 kc and 250 Mc. The special applications discussed below will serve to illustrate the wide range of usefulness of the WV-97A.

Oscillator Grid-Bias Measurement. The negative dc voltage developed at the grid of an oscillator tube is always proportional to the amplitude of oscillation. The WV-97A has high input impedance and can be used to measure this bias voltage. Comparative readings should be taken on each band of a multi-band receiver, and the ganged tuning capacitor should be rotated through each band while the bias is measured.

AVC Voltage Measurements. The WV-97A can be used to measure avc voltage at the diode load resistor, along the avc bus, or at the grids of the controlled tubes.

Output Indication. The WV-97A is a very useful output indicator for alignment of radio and television receivers. The DC Probe is usually connected to the load resistor of the second detector in AM and TV receivers. In an FM receiver, the probe is connected to the limiter load resistor. The zero-center feature of the WV-97A is particularly useful in alignment of FM discriminators.

Bias-Cell Voltage Measurements. Bias-cell voltages can be accurately measured with the WV-97A.

Detection of Gassy Tubes. An occasional gassy tube may be encountered in electronic equipment. The presence of gas in an output tube or avc-controlled tube can lead to various circuit disturbances. Measurement of the grid bias in an RC-coupled circuit shows the presence of a gassy tube as a subnormal or positive value of bias. The same symptom can also be caused by a leaky coupling capacitor.

Insulation-Resistance Measurements. Current leakage through the insulating material of capacitors, coils, transformers, cables, and other components, can be measured with the WV-97A in terms of resistance. Values of leakage resistance above 1000 megohms can be measured with the circuit shown in Fig. 2.

DBM Measurements. The chart shown in Fig. 1 can be used to determine dbm values corresponding to rms ac-voltage values across a 600-ohm resistive load. A dbm value is defined as the number of decibels above or below a reference level of 1 milliwatt in 600 ohms at 1000 cycles. Accordingly, 0 dbm indicates a power level of 1 milliwatt; 10 dbm, 10 milliwatts; 20 dbm, 100 milliwatts; etc.

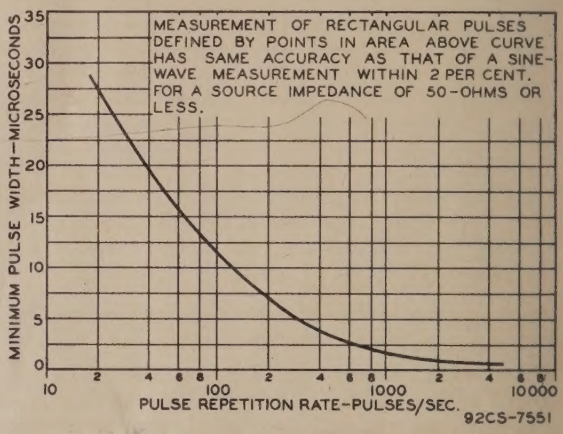


Figure 7. Pulse response capability of WV-97A.

Because dbm are defined with respect to a 600-ohm load, power levels correspond to voltage values. Therefore, dbm can be measured in terms of rms voltages across a 600-ohm resistive load. For example, 0.775 rms volt indicates 0 dbm; 7.75 rms volts indicates 20 dbm, etc. While these measurements must be made with a sine waveform to avoid waveform error, any frequency can be used which is within the range of the WV-97A. The correlation between decibels and ear response is maximum at 1000 cycles.

The chart shown in Fig. 1 provides rapid conversion of rms voltages to corresponding dbm values. Associated power levels can be read along the top of the chart. This chart is applicable to resistive loads other than 600 ohms when a suitable term is added algebraically to the dbm values appearing along the axis of ordinates.

For rms volts measured across a 500-ohm resistive load, add 0.792 dbm algebraically to values read from chart. For rms volts measured across other resistive loads, use formula:

$$\triangle \text{DBM} = 10 \log \frac{600}{R}$$

where R is the load in ohms, and $\triangle$ DBM is the corresponding increment to be added algebraically to the dbm value read from the chart. If $R > 600$, $\triangle$ DBM is negative.

The following table lists the DBM values for most of the load resistances encountered in amplifier work.

Resistive Load at 1000 cps	DBM*
600	0
500	+ 0.8
300	+ 3.0
250	+ 3.8
150	+ 6.0
50	+10.8
15	+16.0
8	+18.8
3.2	+22.7

* DBM is the increment to be added algebraically to the dbm value read from the chart on page 4, figure 1.

Accessories

Available on Separate Order

The WG-264 Crystal Diode Probe consists of a germanium rectifier and an RC network housed in a probe which slips onto the WG-218 (Direct Probe and Cable). The maximum voltage rating of the instrument with the WG-264 is 20 volts rms, in the presence of dc voltages up to 250 volts. The frequency range is 50 kc to 250 Mc. Voltage readings are made on the dc scales in terms of rms volts for sine waves.

The WG-289 High-Voltage Probe in combination with a multiplier resistor (WG-206) extends the dc rating of the WV-97A to a maximum of 50,000 volts for use in high-impedance circuits. DC scales are multiplied by a factor of 100, providing 6 full-scale positions of 150, 500, 1500, 5000, 15,000 and 50,000 volts. When the probe is used, the total input resistance is increased to 1100 megohms, a valuable feature for making measurements in phototube circuits, TV high-voltage power supplies, and other high-impedance circuits having inherently poor regulation.

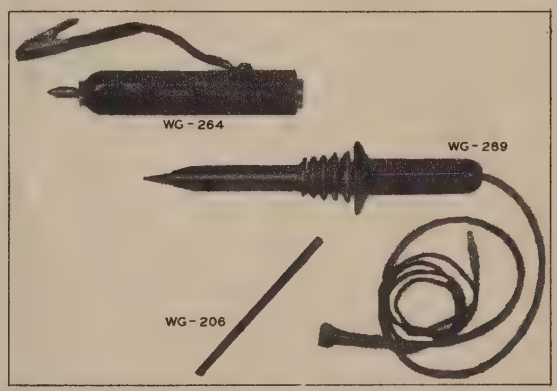


Figure 8. Accessories available on separate order for use with WV-97A.

Maintenance

See "Safety Precautions," page 2.

General

The WV-97A is manufactured and tested under strict engineering supervision. However, after long continued use the instrument may require tube replacement, or other attention.

Locations of calibration controls are shown in Fig. 10. A schematic diagram of the WV-97A is shown in Fig. 9.

The performance of the Senior VoltOhmyst is dependent upon the quality and tolerances of its circuit components. If it becomes necessary to replace a component part, the stock number can be found in the Replacement Parts List, page 13. Only RCA replacement parts, or parts which have equivalent specifications, should be used.

Zero Setting of Pointer

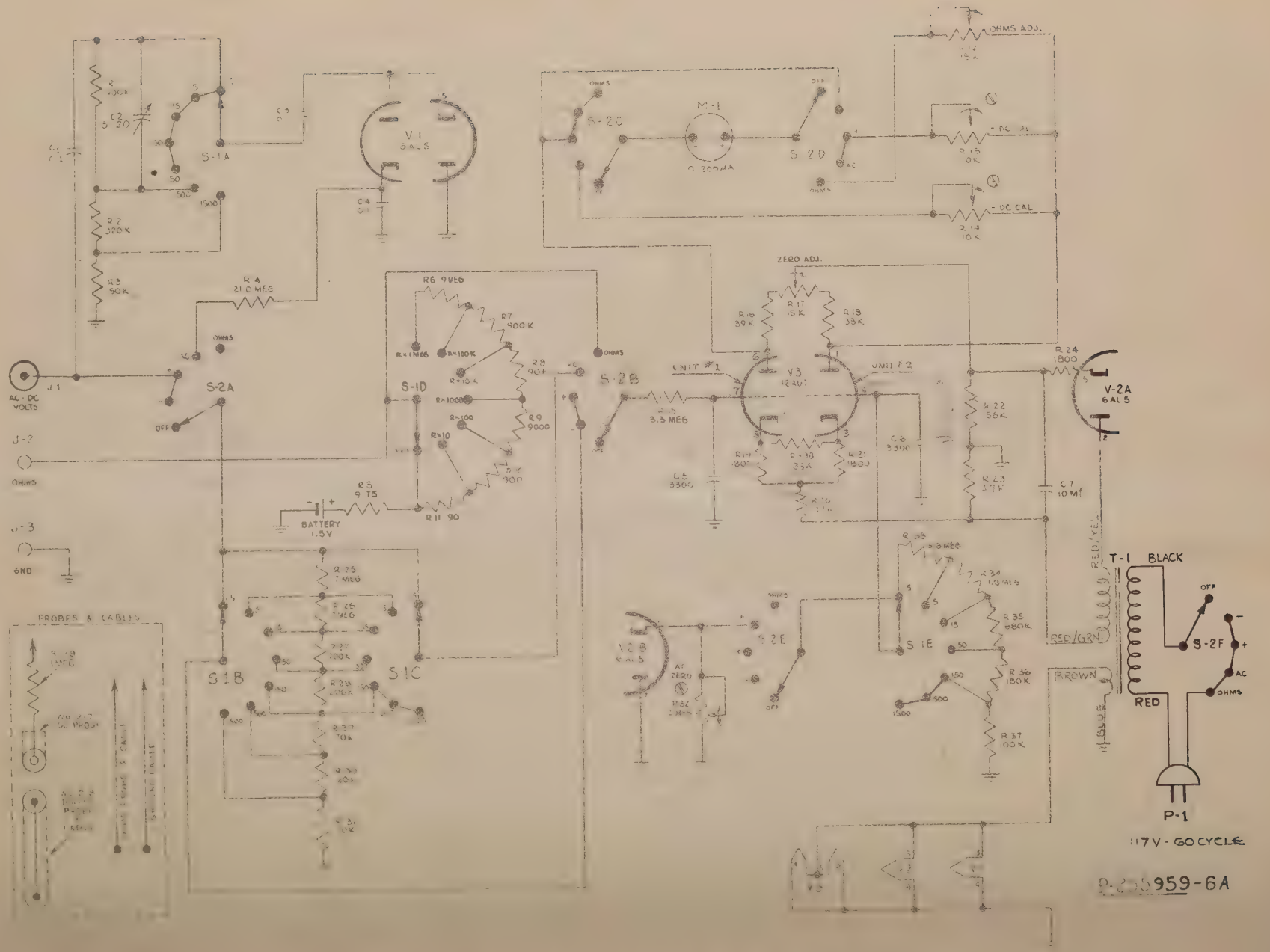
Mechanical Adjustment

The pointer should rest at "0" when the power is shut off. If the pointer should come to rest at a deflected position when the selector switch is turned to "OFF", adjust the pointer position mechanically, as follows:

1. Unscrew the moisture-proof meter-adjustment screw plug.
2. Insert a scriber or similar tool to engage the zero-adjustment lever, and move the lever laterally as required to bring the pointer to "0".

Caution: Extreme care must be taken to prevent insertion of the tool to a depth which will injure the pointer spring. The meter warranty does not cover such damage.

3. Replace the meter-adjustment screw plug.


OHMS ADJ.
R12 15K
S-2C
M-1
0-300MA
S-2D
OFF
AC
OHMS
+DC CAL
R13 5K
-DC CAL
R14 10K
V-1 6AL5
C3 .01
C4 .01
C1 .1
C2 5-20
R1 300K
S-1A
15
3
30
150
500
1500
R2 320K
R3 50K
R4 21.0 MEG
OHMS
AC
J-1
AC-DC VOLTS
S-2A
OFF
J-2
OHMS
J-3
GND
R6 9 MEG
R7 900K
R8 90K
R9 9000
R10 900
R11 90
R5 9.75
BATTERY 1.5V
S-1D
R×1 MEG
R×100K
R×10K
R×1000
R×100
R×10
R×1
S-2B
R15 3.3 MEG
ZERO ADJ.
R17 15K
R18 33K
R19 39K
UNIT #1
UNIT #2
V-3 12AU7
R24 1800
V-2A 6AL5
R22 56K
R23 3.9K
C6 3300
C5 3300
R20 180K
R21 1800
R38 33K
C7 10 MF
R25 7 MEG
R26 2 MEG
R27 700K
R28 200K
R29 70K
R30 20K
R31 7K
S-1B
S-1C
PROBES & CABLE
R39 1 MEG
PROBE & CABLE
R40 .5 MEG
PROBE & CABLE
R41 .1 MEG
PROBE & CABLE
V-2B 6AL5
AC ZERO
R32 2 MEG
S-2E
R34 5.8 MEG
R35 880K
R36 180K
R37 100K
S-1E
R33 1.3 MEG
RED/YEL
RED/GRN
BROWN
BLUE
T-1
BLACK
RED
OFF
S-2F
AC
OHMS
P-1
117V - 60 CYCLE
D-25959-6A

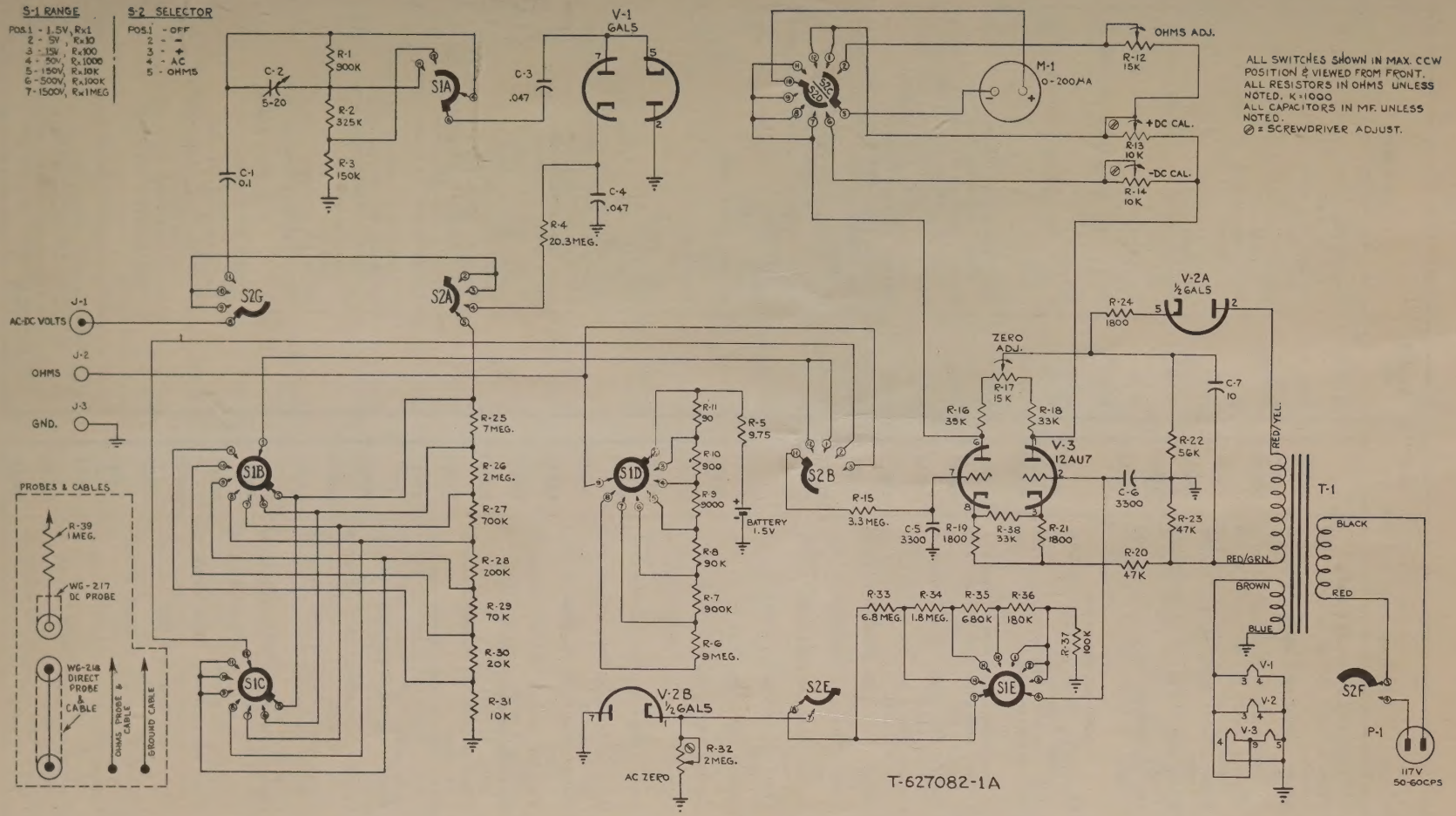


Figure 9B. Schematic diagram for all instruments except those with code number 350.

Replacement Parts List

Symbol No.	Description	Stock No.
	Capacitors, Fixed and Variable	
C 1*	Paper tubular, 0.1 μf ± 20%, 1000 volts	59535
C 1†	Paper tubular, 0.1 μf ± 20%, 600 volts	73557
C 2	Ceramic trimmer, 5-20 μμf, ± 20%	64689
C 3, 4*	Molded paper, 0.1 μf ± 20%, 400 volts	73551
C 3, 4†	Paper tubular, 0.047 μf ± 20%, 400 volts	73553
C 5, 6	Fixed mica, 3300 μμf ± 20%, 600 volts	39664
C 7	Dry electrolytic, 10 μf ± 20%, 150 volts	56234
	Jacks and Connectors	
J 1	Connector, male, single contact, chassis mounting	96257
J 2, 3*	Jack, single contact	55239
J 2, 3†	Jack, single contact	93858
	Resistors, Fixed and Variable	
R 1	Carbon film type, 900,000 ohms ± 1%, 1 watt	59536
R 2*	Carbon film type, 320,000 ohms ± 1%, ½ watt	59544
R 2†	Carbon film type, 325,000 ohms ± 1%, ½ watt	93872
R 3	Carbon film type, 150,000 ohms ± 1%, ½ watt	56483
R 4*	Carbon film type, 21.0 meg., ± 1%, 1 watt	59537
R 4†	Carbon film type, 20.3 meg., ± 1%, 1 watt	93871
R 5	Fixed wire wound, 9.7 ohms ± 1%, 1 watt	96613
R 6	Carbon film type, 9 meg., ± 1%, 1 watt	59539
R 7	Carbon film type, 900,000 ohms ± 1%, ½ watt	55661
R 8	Carbon film type, 90,000 ohms ± 1%, ½ watt	56725
R 9	Carbon film type, 9000 ohms ± 1%, ½ watt	56723
R 10	Carbon film type, 900 ohms ± 1%, ½ watt	54197
R 11	Carbon film type, 90 ohms ± 1%, 1 watt	96614
R 12	Variable carbon, 15,000 ohms ± 20%, ½ watt	59532
R 13, 14	Variable carbon, 10,000 ohms ± 20%, ¼ watt	59533
R 15	Fixed composition, 3.3 meg., ± 10%, ½ watt	31417
R 16	Fixed composition, 39,000 ohms ± 5%, ½ watt	30147
R 17	Same as R 12	—
R 18	Fixed composition, 33,000 ohms ± 5%, ½ watt	30685
R 19	Fixed composition, 1800 ohms ± 5%, ½ watt	30930
R 20	Fixed composition, 47,000 ohms ± 5%, ½ watt	30787
R 21	Same as R 19	—
R 22	Fixed composition, 56,000 ohms ± 5%, ½ watt	30650
R 23	Fixed composition, 47,000 ohms ± 5%, ½ watt	30787
R 24	Fixed composition, 1800 ohms ± 5%, ½ watt	30930
R 25	Carbon film type, 7.0 meg., ± 1%, 1 watt	59538
R 26	Carbon film type, 2 meg., ± 1%, ½ watt	59540
R 27	Carbon film type, 700,000 ohms ± 1%, ½ watt	59541
R 28	Carbon film type, 200,000 ohms ± 1%, ½ watt	56733
R 29	Carbon film type, 70,000 ohms ± 1%, ½ watt	59542
R 30	Carbon film type, 20,000 ohms ± 1%, ½ watt	59177
R 31	Carbon film type, 10,000 ohms ± 1%, ½ watt	55665
R 32	Variable carbon, 2 meg., ± 20%, ½ watt	59534
R 33	Fixed composition, 6.8 meg., ± 5%, ½ watt	31071
R 34	Fixed composition, 1.8 meg., ± 5%, ½ watt	11769
R 35	Fixed composition, 680,000 ohms ± 5%, ½ watt	30562
R 36	Fixed composition, 180,000 ohms ± 5%, ½ watt	11959
R 37	Fixed composition, 100,000 ohms ± 5%, ½ watt	3252
R 38	Same as R 18	—
R 39	Fixed composition, 1.0 meg., ± 5%, ½ watt	30652
	* * * * *	
S 1*	Switch, rotary, "Range", 7 positions, 3 sections, 5 circuits	59525
S 1†	Switch, rotary, "Range", 7 positions, 3 sections, 5 circuits	93868
S 2*	Switch, rotary, "Selector", 5 positions, 2 sections, 4 circuits	59526
S 2†	Switch, rotary, "Selector", 5 positions, 3 sections, 4 circuits	93867
T 1	Transformer, power, 117 volts, 50/60 cycles	59527
	Miscellaneous	
	Cable, ground (black), with alligator clip	48996●
	Cable, ground (black), with alligator clip	93832◆
	Cable, ohms, with probe and pin plug	51960●
	Cable, ohms, with probe and pin plug	93859◆
	Case, meter	93811
	Clamp, battery	59524
	Clip, alligator, "slip-on" type	59410
	Clip, alligator, for ground cable	35262
	Connector, cable, chassis receptacle	96257
	Handle, carrying case	44091
	Jack, ohms or ground	55239●
	Jack, ohms or ground	93858◆
	Knob, control, large	59543
	Knob, control, small	53689
	Meter, 0 to 200 μamp	59523
	Pin plug, black, for ground cable	47089●
	Pin plug, black, for ground cable	93856◆
	Pin plug, red, for ohms cable	47089▲
	Pin plug, red, for ohms cable	93857◆
	WG-218 Direct Probe and Cable	
	Cable, rf coaxial, 38″ long	RG62U
	Connector, threaded, microphone-type	48982
	Connector, with tip, for front end of probe	96318
	Shell, polystyrene, black	59529
	Sleeve, polystyrene, threaded	59530
	WG-217 DC Probe	
	Connector, female	59547
	Insert	59548
	Nut, hex head, # 12-24	—
R 501	Resistor, fixed composition, 1 meg. ± 5%, ½ watt	502510
	Screw, flat head, 4-40, 5/32″ long	—
	Shell, polystyrene, black	59549
	Shield	59550
	Tip	59551

* For instruments with code no. 350.
† For all instruments except code no. 350.
● For instruments with code nos. 350 and 850.
◆ For all instruments except code nos. 350 and 850.
▲ For code nos. 350 and 850, red plug is not available. Order black plug, stock no. 47089.

Electrical Balance Check

1. Set the function selector to "+VOLTS".

2. By rotating the ZERO ADJ control, it should be possible to set the meter pointer at either zero or 60% of full deflection on any range.

3. Set the function selector to "—VOLTS".

4. By rotating the ZERO ADJ control, it should be possible to set the meter pointer at either zero or 10% of full deflection on any range.

5. If steps 2 and 4 above cannot be accomplished, the two triode units of the 12AU7 tubes are not in close enough balance for this application and the tube should be replaced. Refer to Tube Replacement section.

Meter Response

For those instruments with code No. 350, a time delay will be observed after ac measurements are made. This will ensue from the instant that the leads are removed from the voltage source being measured to the instant the meter pointer returns to "O". This delay is normal and is caused by circuit constants so chosen that recurrent pulses with low repetition rates may be accurately measured. In applications where it is desirable to measure recurrent pulses with relatively high repetition rates, the time required for the meter needle to return to "0" may be decreased by reducing the value of capacitors C-3 and C-4 trom 0.1 μf to 0.047 μf.

Calibration

If it becomes necessary to recalibrate the WV-97A, proceed as follows to restore the initial accuracy of the instrument:

Note: The accuracy of calibration cannot exceed the accuracy of the voltage standards which are used.

DC Calibration

1. Check the mechanical zero position of the pointer. If necessary, zero the pointer as described above.

2. Turn selector switch to "+VOLTS" and allow the WV-97A to warm up for at least 30 minutes.

3. Check line voltage. The WV-97A should be calibrated at 117 volts, 60 cycles.

4. Rotate the ZERO ADJ control (R17) to bring the pointer exactly to "0". (This control is not used again in the calibration procedure.)

5. Set range selector to the "50 V" position.

6. Connect the black-lead clip to the negative terminal of an accurate 50-volt dc source. Connect the DC Probe to the positive terminal of the source voltage.

7. Adjust the "+DC CAL" control (R13) to bring the pointer exactly to the 50-volt point on the scale. (Refer to Fig. 10)

8. Reverse the test-lead connections to the voltage source.

9. Set function selector to the "—VOLTS" position.

10. Adjust the "—DC CAL" control (R14) to bring the pointer exactly to the 50-volt point on the scale.

11. Check the other dc ranges from other dc sources which provide full-scale deflection and which have accurately known voltages.

AC Calibration Check

If ac calibration has not been preceded by dc calibration, first follow the four initial steps under DC Calibration. Then proceed as follows:

1. Remove WG-217 DC Probe from WG-218 Direct Probe and Cable.

2. Set function selector to "AC VOLTS".

3. Set range selector to "1.5 VOLTS".

4. Adjust the AC ZERO screwdriver control at the rear of the instrument for a zero meter reading. The probe (WG-218) tip should be connected to the ground clip for this adjustment. If a zero meter reading cannot be obtained, interchange the two 6AL5 tubes. If the pointer cannot be brought to zero after the interchange of tubes, replace 6AL5 tubes. Refer to Tube Replacement section.

5. Apply 50 volts, 60 cps between the ground lead and the tip of the WG-218 Direct Probe and Cable. The meter reading should read within the accuracy stated in the Specifications section of this manual. If it does not, check values of circuit components.

AC Compensation Adjustment

1. Remove WG-217 DC Probe from WG-218 Direct Probe and Cable.

2. Set function selector to "AC VOLTS".

3. Set meter pointer at zero.

4. Set the function selector on the 500-volt range and apply an accurate 200-volt, 100-kc sine-wave signal between the ground lead and tip of the WG-218 Direct Probe and Cable. Adjust C-2 located at the rear of the instrument (see Fig. 10) for a 200-volt meter reading.

Ohms Adjustment

In order to obtain exactly full-scale deflection of the meter when switching the range selector from a low range position to the "RX1 MEG" position, it may be necessary to readjust the OHMS ADJ control. The necessity for this readjustment can be eliminated by using a battery in good condition and by installing a 12AU7 tube which has a low value of grid current.

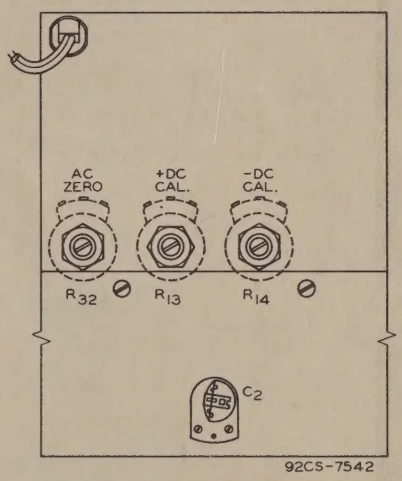


Figure 10. Calibration control locations.

Tube Replacement

If it is necessary to replace one of the 6AL5 tubes, the tube should be aged by running the tube at normal heater voltage for at least 24 hours before installation.

The 12AU7 may be aged by tying the grid to the cathode and applying 110 volts 60 cycles between the cathode and plate. The heater should be run at normal voltage and the tube aged for at least 12 hours.

Battery Testing and Replacement

Caution: Do not allow exhausted cells to remain inside the case of the WV-97A. Chemicals from deteriorated cells may damage the instrument.

The battery should be tested frequently to insure accuracy of resistance measurements. To test battery, proceed as follows:

1. Set Function selector to "OHMS".

2. Set Range selector to "RXI" scale.

3. Rotate OHMS ADJ control to bring pointer to full scale.

4. Short-circuit Ohms Probe and Ground Clip for about ten seconds.

5. Open the short-circuit and immediately observe the scale indication. An appreciable deviation from full-scale indication reveals weak cells which should be replaced.

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